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AN EFFICIENT DRAINAGE SYSTEM FOR SUGARCANE

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X AN EFFICIENT DRAINAGE SYSTEM FOR SUGARCANE X

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The sugarcane section of Louisiana, with a high-intensity, average annual rainfall of 60 inches, requires adequate surface drainage. The present drainage system, over a century old, was predicated on the use of hand labor and mules for sugarcane production and drainage maintenance. Sugarcane planters and agricultural workers have long voiced the need for a more efficient system that is applicable to mechanization of sugarcane production and drainage maintenance.

TYPICAL DRAINAGE SYSTEM

Figure 1 illustrates a typical sugarcane drainage system which consists of a series of lateral ditches (called split ditches) and cross drains (called quarter drains). The lateral ditches run with the general slope of the land, are spaced from 100 to 250 feet apart, and empty into a drainage canal or cross ditch. The lateral ditches range from 18 to 36 inches deep and are approximately 4 feet wide at the top and 2 feet wide at the bottom. To provide a headland crossing, a culvert is placed in the lateral ditches at approximately every 1,000 feet. This determines the length of the area worked, known as a cut. The width of a cut is determined by the lateral ditch spacing.

Since sugarcane is grown on bedded rows 18 inches high, 6 feet apart, and parallel to the lateral ditches, cross drains (quarter drains) are cut through the rows to transmit excess rainfall to the lateral ditches. There are usually four quarter drains per cut.

The sugarcane drainage system requires a mile of lateral ditches to every 14 to 20 acres of land. Five years of accurate records on 2,040 acres reveal the following maintenance cost per annum per acre:

Lateral Ditches, \$3.58.--Lateral ditches are rehabilitated after each 3-year cycle of sugarcane by cleaning them with a ditching attachment on a cane loader. The sides are reshaped and approximately 1 foot of earth is removed from the bottom of the ditch. The ditches are mowed at least once a year before the cane is laid by.

Quarter Drains, \$3.04.--Quarter drains consist of a furrow through the rows that is opened with a plow after each cultivation and the earth shoveled out of each row middle by hand.

Outlet Canals, \$0.89.--Outlet canals are mowed or chemically treated at least twice a year and the silt removed after each cycle of sugarcane with a dragline. They are redug every 6 to 8 years.

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Figure 1.--Typical sugarcane drainage system in Louisiana.

COTTON DRAINAGE SYSTEM ADAPTED TO SUGARCANE

In the cotton drainage system of Louisiana, 1 mile of ditch or field drain serves approximately 50 acres of land. This is two to three times that served by a ditch in the sugarcane area. Each row in the cotton drainage system carries its own water to a field drain adjacent to a headland which transmits it to an outlet ditch (fig. 2). This system does not require quarter drains. However, the equipment crosses field drains during the farming operations.

In a joint conference with employees of the Soil Conservation Service in the spring of 1956, Agricultural Research Service personnel decided to experiment with a system for the sugarcane area by combining the successful cotton drainage system with precision land forming. Precision land forming shapes the field into a smooth plane to facilitate removing excess rainfall from the field into the field drains.

Sugarcane production requires heavier equipment than cotton production, especially in harvesting. A sugarcane harvester weighs from 8 to 10 tons. In hauling the cane from the field, one tractor usually pulls two 2-wheeled carts, each loaded with 2 tons or more of cane. In adapting the cotton-drainage system, the big question was what difficulties would be encountered with heavier equipment crossing the field drains below graded sections of a field, especially

LOUISIANA COTTON DRAINAGE SYSTEM

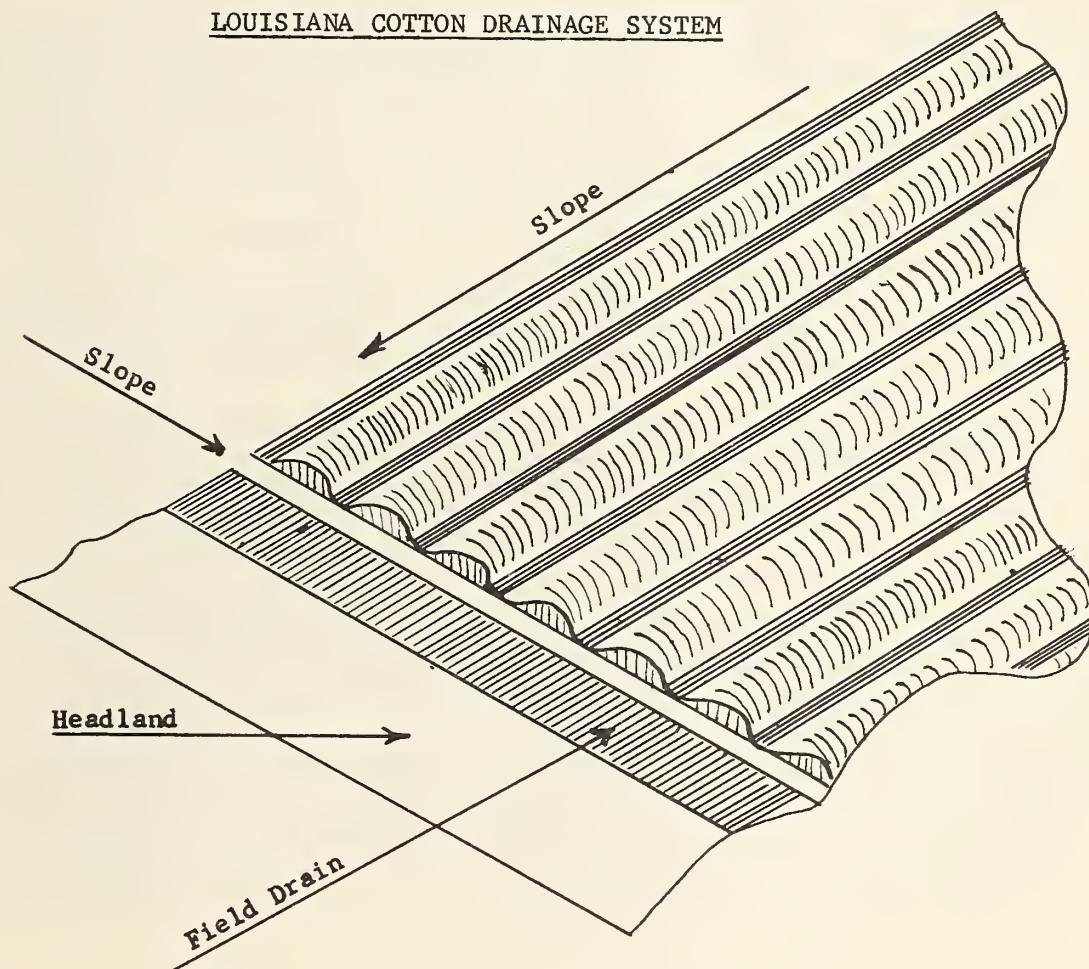


Figure 2

during wet harvests. Other factors to be evaluated were maintenance cost and adequacy of surface drainage. Results of studies initiated in 1956 to answer these questions are given below.

Experimental Area

1. Location.--Margaret Plantation, Port Allen, Louisiana.
2. Total area.--Approximately 29 acres, consisting of 13 cuts divided by 10 lateral ditches and 2 cross ditches, totalling 6,552 feet and consuming 1.8 acres. (fig. 3).
3. Soil type.--Medium-textured Mhoon silt loam.

Procedure Used

1. The lateral ditches were filled and the area was smoothed with a land leveler.
2. A topographic survey was made in which 100-foot grids were used.
3. The area was divided into three blocks, field drains were located, and grades were determined for both fields and field drains.
4. The area was staked and worked in June and July 1956, as shown in figure 4.
5. The area was kept fallow after land forming until the spring of 1957, when it was planted to corn. An annual crop permits the correction of discrepancies in land forming after one crop year, whereas sugarcane is a ratoon crop that remains for at least 3 years. Should sugarcane be used the first year after forming, any discrepancies would affect at least three consecutive sugarcane crops. The discrepancies are usually the settlement of fill areas that require additional fill.
6. After harvesting the corn, the small pockets caused by settling were refilled and the entire area was smoothed with a land leveler.
7. The field drains were originally cut with side slopes of 6:1. Because this was too steep on the headland side for cultivating the corn, the slope was flattened to 10:1. The 6:1 side slope on the field side did not interfere, since very little slope was left after the field was put up in rows.
8. The test area was planted to sugarcane in the fall of 1958 and the first crop was harvested in the late fall of 1959.

Results

1. The land forming required the moving of 164 cubic yards of earth per acre at a cost of \$68.45. (Details of land forming are included in the Appendix.)
2. The new drainage system for this area of 29 acres has 1,740 feet of ditches and field drains, which consume 0.48 acre of land.
3. Of the total acreage (1.32 acres) originally in lateral ditches, 4.75 percent was made available for growing sugarcane. This does not include the area occupied by quarter drains.
4. It was not necessary to maintain quarter drains, which eliminated the cost of \$3.04 per acre required under the conventional system.

5. Tillage and harvesting operations were carried out with no more difficulty than with the conventional sugarcane drainage system for the 3 years this area was in sugarcane.

The harvesters and tractors with loaded cane carts crossed the field drains with no difficulty. However, tractor operators should be trained to raise their implements to continue in the row middle to the ditch. The implements are suspended behind the tractor and when the ditch is crossed the front tractor wheels are raised above the rear wheels, causing the implement to go deeper. If not raised at the right time, the implement makes a depression about 3 feet from the ditch, which will impound water. If raised too fast, soil is left in the middle, which impedes drainage.

6. Harvesting was easier during wet periods in the formed and smoothed fields than in those using conventional drainage. However, field observations indicate that the 0.08 ft. and 0.05 ft. slopes per 100 feet are too flat for both construction and farming purposes. Slopes this flat are extremely difficult to grade to and any small discrepancies in land forming are magnified. Also, any earth, such as clods, impounds water to a greater extent than on a field with more slope. A slope of 0.2 foot is preferable, if the topography will permit it without excessive earth moving.
7. Field drains are located along the headlands where they are accessible for mowing johnsongrass and other weeds.
8. Annual maintenance costs for this area over a 3-year period were \$0.78 per acre for field drains and \$1.51 per acre for outlet ditches, for a total of \$2.29. This represents a saving of \$5.22 per acre in comparison with the conventional type, which cost \$7.51.
9. Yield data from the first cycle of sugarcane were:

YEAR	TEST AREA <u>Tons/Acre</u>	CHECK <u>Tons/Acre</u>
1959	34.13	32.10
1960	33.57	31.25
1961	31.60	(1)

10. This new drainage system has spread rapidly to a number of cooperators in Soil Conservation Districts. One district reports 449 acres with this system on 10 different farms; an average of 358 cubic yards of earth was moved per acre. Most of these cooperators are quite enthusiastic about this system and plan to work additional areas. Some of the new drainage system areas were in cane in 1961 and were harvested under extremely wet conditions with less difficulty than in the conventionally drained fields. Project observations at other locations and reports from district cooperators are comparable to results on the Margaret plantation district's test areas. One exception to the test area is the amount of earth moved in other districts, which is larger because of topography, but is more typical of normal field conditions than is the test area.
11. The cost for installing the cotton drainage system varied with the topography and local rates of machine hire, and ranged from \$70 to \$90 per acre. The cost depended on the amount of earth moving required, which was from 300 to 400 cubic yards per acre.

¹No 2d stubble check available.

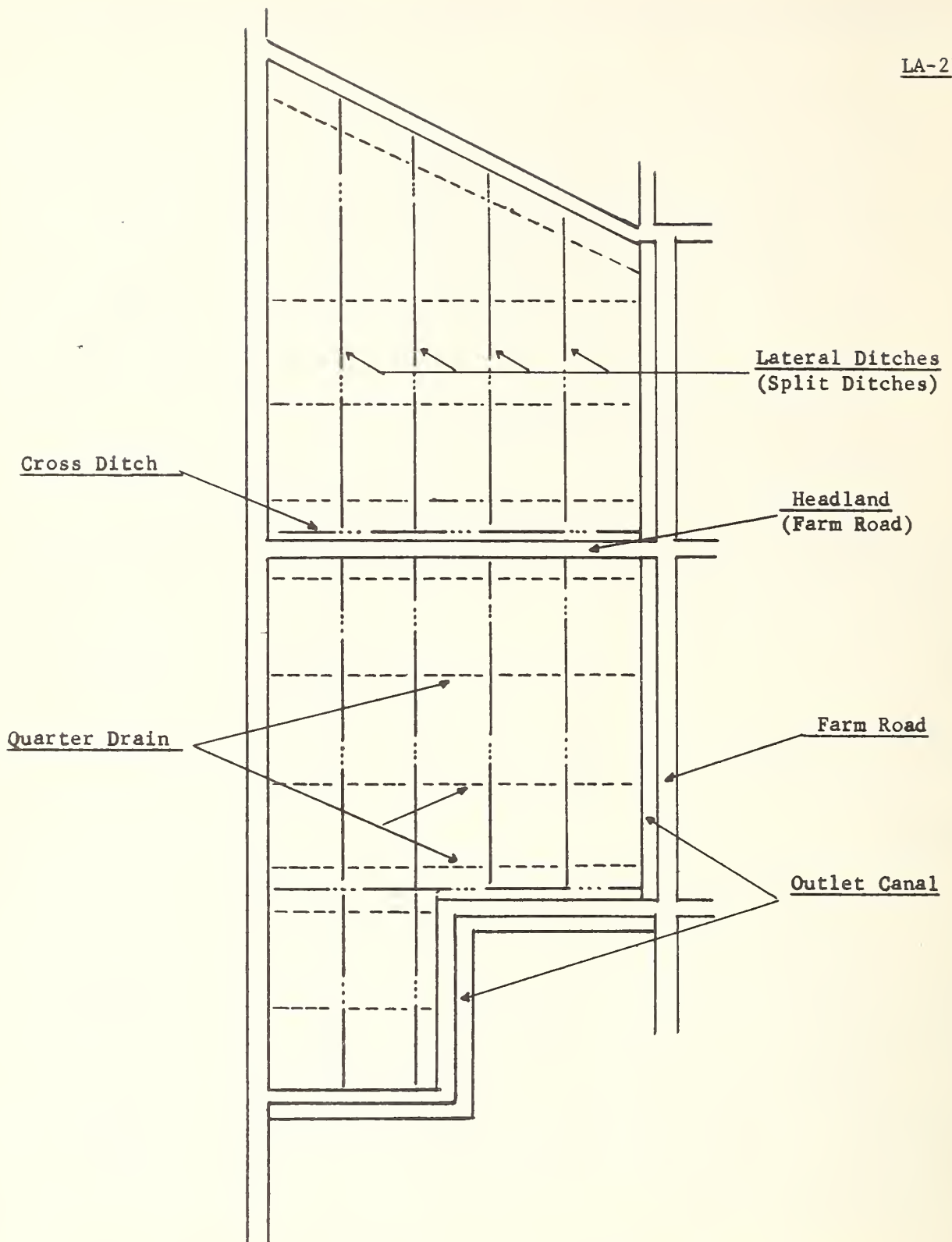


Figure 3.--Original drainage layout (before working) of sugarcane field at Margaret Plantation, Port Allen, La.

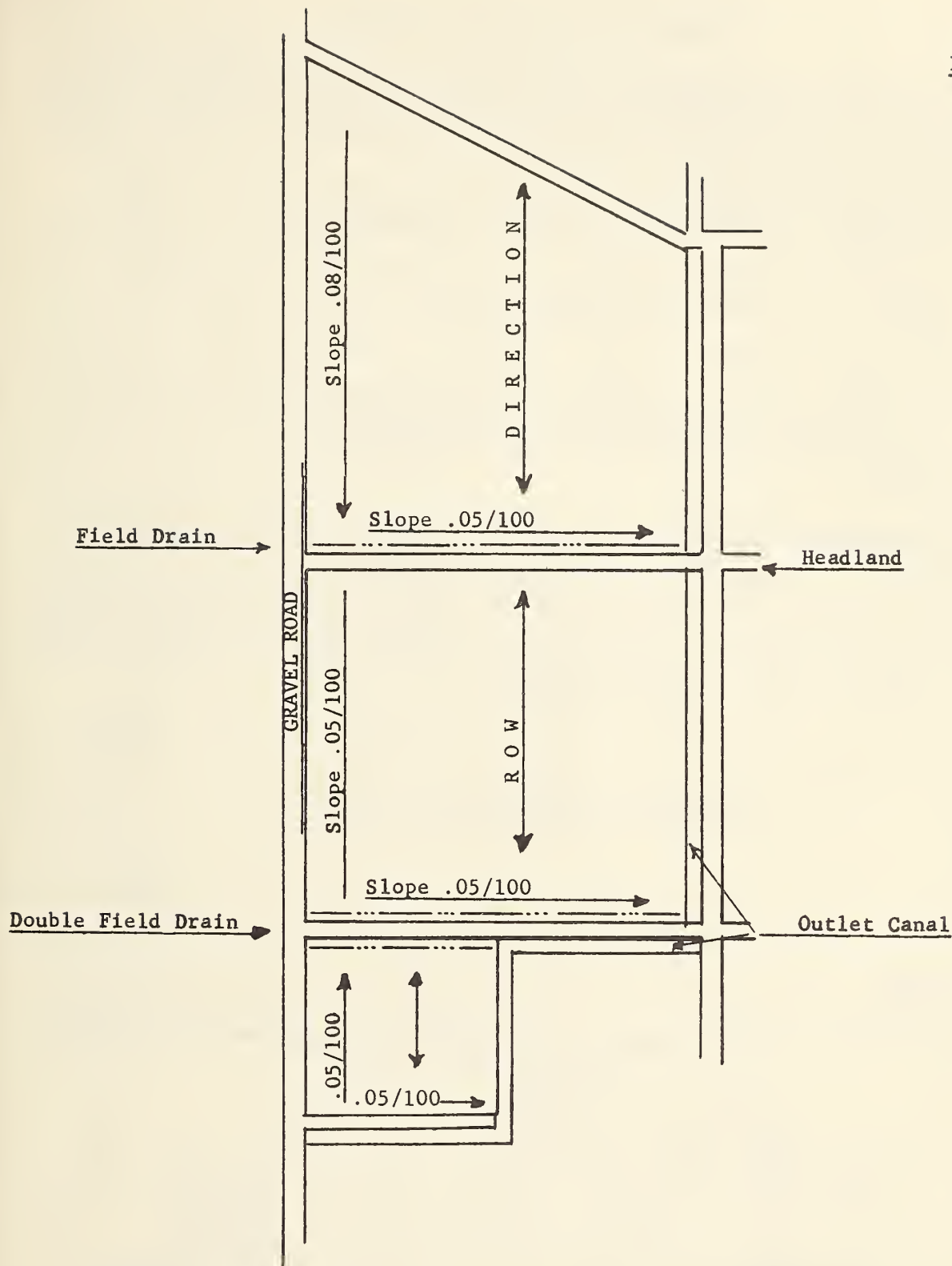


Figure 4.--Revised drainage layout of sugarcane field at Margaret Plantation, Port Allen, La., (26.37 acre in crop; 28.69 acre total).

SUMMARY AND CONCLUSIONS

The success of the experiment at Port Allen and those of the Soil Conservation District cooperators have definitely proved that the cotton-type drainage system combined with land forming can be used for sugarcane production on medium-textured soils. The chief benefits derived from this system were:

1. There were no quarter drains to maintain.
2. Field drains were accessible for mowing and maintaining with farm tractors and small pull graders.
3. The precision-formed fields were free of depressions, thus providing better surface drainage and permitting more efficient equipment operation, especially during wet harvests.
4. Four to seven percent more land originally in ditches was available for sugarcane production.
5. Field drains were crossed by farm machines with little difficulty in tilling and harvesting.
6. Yields of sugarcane increased 2 tons or more per acre.
7. Annual maintenance costs were \$5.22 per acre less than with the conventional drainage system.

RECOMMENDATIONS FOR INSTALLING AND MAINTAINING THE SYSTEM

1. The field should be sloped from the headland to the field drain. Use 0.2 ft. per 100 feet with a minimum of 0.1 ft. per 100 feet if the earth moving is not excessive. The side slope of the field determines the grade of the field drains, which should not be less than 0.1 ft. per 100 feet.
2. The field drain should be 12 inches deep with a minimum of 10:1 slope on the headland side and a minimum of 6:1 on the field side. See fig. 5.

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RECOMMENDED FIELD DRAIN CROSS SECTION

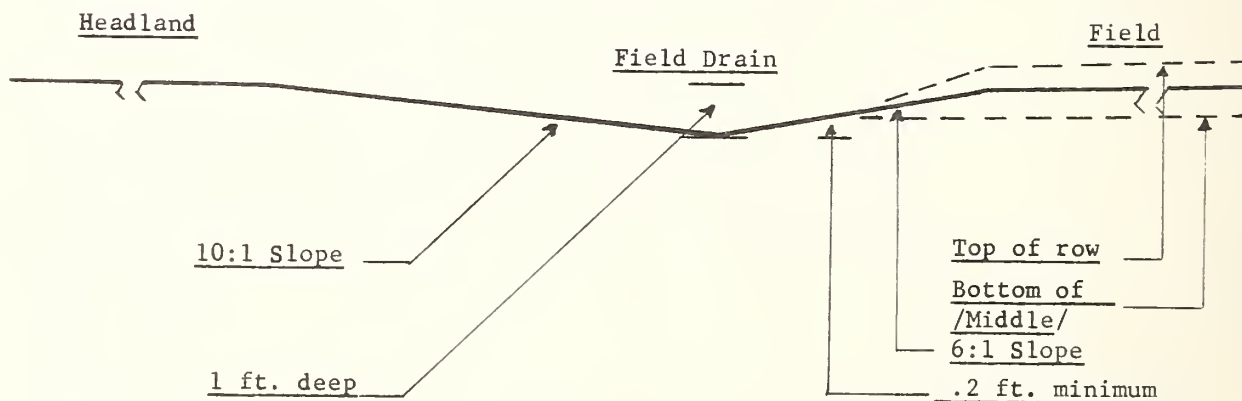


Figure 5.--Layout of recommended field drain cross section for sugarcane.

3. Plant first an annual crop after working the field, since fill settles the first year and minor reworking is necessary. After this, plant the cane crop.
4. Clean the field drains after lay-by, to remove any earth left in the field drain from the tillage operations. Clean the drains immediately after harvesting, to remove the cane trash and scars that may impound water and interfere with the drainage over winter for the next crop.
5. In preparing the land for replanting, flush (plow flat) and smooth with a land leveler; put up in rows; and then fallow by row-breaking instead of flush plowing to eliminate dead and back furrows.

APPENDIX

Grading Information, Drainage Test Area Margaret Plantation - Port Allen, La.

Plot No.	Acres	Grading (forming)				
		Cubic yards	Yards per acre	Hours grading	Yards per hour	Hours per acre
1	14.12	2,422	171.53	47	52	3.33
2	11.59	1,881	162.29	41)	48.6	3.43
3	2.98	411	137.91	) 50 9)	----	----
Total or Average	28.69	4,714	164.31	97	50.3	3.38
Leveling (smoothing)	28.69	-----		66	----	<u>2.30</u>
Total forming and smoothing		-----				5.68
Cutting ditches		-----		15	----	.52
Cutting headland		-----		7	----	<u>.24</u>
Total per acre for complete operation						6.44

	Average	Grading Maximum	Minimum
	(Foot)	(Foot)	(Foot)
Cut	0.10 - 0.20	0.50	0.05
Fill	0.17 - 0.20	0.40	0.05

Average hauling distance for earth:

Plot 1, approximately 500 feet; Plots 2, 3, approximately 700 feet

Started grading operations June 8, 1956.

Completed July 14, 1956.

**Cost Data
Drainage Test Area**

Equipment used ¹	Job performed	Hours worked	Rate per hour	Cost
Caterpillar D-7 tractor & scraper (on rubber)	Forming land	77	\$12.00	\$924.00
Caterpillar D-6 tractor & scraper (on rubber)	Forming land and cutting headland	13	10.00	130.00
Caterpillar tractor and land leveler	Smoothing	66	10.00	660.00
Caterpillar D-7 tractor & scraper	Cutting ditches	15	12.00	180.00
Caterpillar D-6 tractor & scraper (on rubber)	Reducing headland	7	10.00	70.00
Total cost				\$1,964.00

¹Trade names and company names are included for the benefit of the reader and do not infer any endorsement or preferential treatment of the product listed by the Department of Agriculture.

